FCC Hearing

Albuquerque, NM
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Overcoming Obstacles to Telephone Service for Indians on Reservations

Industry Viewpoint:

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Docket # 99-11

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Written Testimony
Summary provided by Mr. Carson

Summary:

Introduction - This vital hearing brings into focus the telecommunications needs of over two million native Americans, and the opportunities and challenges they pose to an industry during its most dynamic period of change. The social and economic vitality of any present-day nation can be measured in part by the breadth (capabilities) and reach (accessibility) of its national information and telecom infrastructure. The challenge before us is to find common ground on which the industry and regulators can address the dearth of telecommunications services among the reservations on which 2 million native Americans live.

Situation - Most, if not all, of the major communications industries in the U.S. were created with substantial government support (e.g., the Internet) or regulatory oversight (e.g., long distance and cellular). Naturally, those segments that saw the most widespread competition (i.e., the long distance and Internet markets) offered customers more choice and have expanded and reduced prices faster than their monopoly (local exchange) and duopoly (cellular) counterparts. Cellular hasn't provided an economically viable option to basic phone service primarily because it was optimized for high-mobility and as a result, carries a substantial cost premium which makes it unattractive to price-sensitive telephone users.

Strength of Incumbents - By granting incumbent telephone companies cellular licenses in 100% of their top markets[1], regulators inadvertently strengthened the incumbents' dominant position in the voice telephony market. After all, cellular in essence is *mobile* voice telephony. The profitability of their wireline monopolies and the absence of significant spectrum costs afforded the telco-owned cellular operators an unprecedented and yet unmatched financial boost.

Fragmentation of Competition - Subsequent wireless licenses, such as PCS and WCS, were offered in regional and local geographic units (e.g., MTA, REAG and BTA). This, and the current environment of open and unrestricted spectrum auctions, while initially yielding immense auction proceeds, allowed large telcos to outbid most challengers and hindered the emergence of broad-based competition from new wireless operators with nationwide presence (spectrum footprint)[2]. New entrants, in order to establish a nationwide marketing presence, had to do so largely through resale or roaming agreements, resulting in higher prices for customers or lower profit margins[3].

Frequency Pairing - The historical pairing of frequencies has perpetuated the dominance of incumbent cellular operators and their powerful suppliers, due to technology inertia (a push for *off-the-shelf* cellular-like technologies that *fit* the paired bands). This has left few opportunities for challengers to differentiate themselves and has impeded and technology innovation.

New Technologies - New, commercially-proven wireless local loop (WLL) systems exist that will allow access network operators to competitively address low-density geographic and price-sensitive user segments. These new systems make use of smart antennas, which provide fundamental improvements in coverage, quality and capacity, and time-division duplex technology (TDD), which carries transmit and receive traffic on the same radio frequency (in unpaired bands). Such technologies, as applied to WLL applications, are proven to economically outperform wired telephony in virtually all markets[4].

Internet Solutions - Indians rightly want more than just basic telephony. The advantages of these new systems in data applications are even more profound. Smart antennas and TDD technology uniquely provide the required radio performance and bandwidth management[5] to enable tetherless, high-speed Internet access to be offered at

[1] Defined as those markets falling with the top 90 metropolitan service areas.
[2] For example, Most RBOCs won PCS licenses where they bid on A and B block auctions. Bell South purchased all 4 WCS bands in the Southeast REAG, keeping WCS competition out of their Southeast local exchange markets and preventing any competitive WCS operator from emerging with a nationwide footprint.
[3] Example: a CDMA operator Y competes with incumbent Z in N.Y., but resells airtime on incumbent Z's CDMA network in L.A. (through roaming or resale) because it was outbid for the L.A. regional license. The result is less intense nationwide competition and higher prices.
[4] For example, IntelliWave™, a commercial smart-antenna-enabled WLL system can be deployed for less than $600 investment per subsriber (vs. approximately $3,000 for the wired telephone network) in areas with as few as 2-3 subscribers per square km.
[5] Because Internet traffic is highly asymmetric, new TDD systems operating in unpaired bands can reorganize timeslots and make better use of spectrum than FDD-based systems operating in symmetrically-paired frequencies.

prices equivalent to or lower than today's low-speed dial-up services[6]. The result is that literally millions of wireless Internet users can be served at low cost with as little as 5 -10 MHz of unpaired radio spectrum. This spectral efficiency, along with differentiation, cost advantages and ease of implementation/maintenance, substantially reduce the barriers to facilities-based wireless competition.

Recommendations:

Such systems, along with the new competitors and services that they will give rise to, cannot flourish without the kind of regulatory support offered these technologies in Europe and Asia. In the interest of Indian consumers, and the public at large, we suggest that regulators consider adopting the following policies:

- Consider alternative spectrum bidding methods. Eliminate auction fees in exchange for minimum service commitments on Indian reservations by new wireless licensees. Also consider technical (spectral efficiency) and commercial (price) merits.
- In exchange for complying with minimum service commitments on Indian reservations, make available government subsidy programs, i.e., *Lifeline*, to qualifying Indian subscribers of licensees' wireless telephony and wireless Internet services.
- Allocate available frequencies, mostly notably those covered under the Omnibus Reconciliation Act and the Balanced Budget Amendment, as *unpaired* bands to foster widespread use of new, smarter systems and a new breed of competition.
- Offer licenses with nationwide footprints to attract more investment capital, create stronger competition, give providers of Indian telecom service access to larger economies of scale and offset the risk of deploying newer technologies.
- Give higher priority to spectrum below 2-3 GHz, which will result in better propagation characteristics (coverage) and translate into more economically viable networks, especially for those serving sparsely-populated Indian reservations.
- Slice spectrum into more licenses with moderate allocations (e.g., unpaired 5 - 15 MHz) to stimulate broad-based competition and the use of more competitive, spectrally-efficient technologies.
- Through emissions rules, ensure better adjacent band coexistence for TDD systems than has been offered in the past.
- Consider spectrum caps on incumbent/dominant wireless operators and on ILECs to ensure diversity of competition and prevent preemptive bidding by incumbents to impede competition.
- If recommendation #1 is adopted, consider ways to include Indians in the development of commercial selection criteria for merit-based bidding. Criteria can be very simple, i.e., coverage milestones, service price levels.
- Consider ways to include Indians either in adjudication of such tenders, as described in recommendations #1 and 9, or as equity partners in the license. This may lead to better cooperation, technology transfer and better Indian self-sufficiency.
- Fresh technical and regulatory approaches are needed to stimulate facilities-based competition and to break a pattern of stagnation in the local exchange sector.

We are confident that our recommendations, if adopted, can dramatically improve the state of telecommunications services on Indian reservations and the competitiveness of the wireless industry at large because:

1. all parties involved (users, regulators and the industry) appear to be willing to cooperate;
2. Indians want more than just basic telephony -- their economic development depends, in part, on data access;
3. new providers need to offer more than just basic telephone service in order to be economically viable;
4. commercially viable access technologies are now available, namely in the area of wireless telephony and data, and
5. the right regulatory solutions will stimulate a climate of investment for suppliers and choice for end users

[6] High speed is defined as LAN-like data rates (hundreds of kbps - 1 Mbps). Low-speed dial-up service typically connects at about 28-56 kbps.

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} Wireless Telephony Alternatives

} Technological Developments

} Wireless Telephony Solutions; WLL Example

} Wireless Telephony Economics

} Regulatory Policy Issues

Background
ArrayComm

- Founded in 1992; Headquartered in San Jose, California
- Develops, supplies and licenses wireless local loop infrastructure and subscriber equipment
- Develops and and licenses smart antenna technology/software for cellular, cordless and wireless local loop (WLL) systems
- Systems deployed in Asia, Latin America, Middle East and Europe

Background

Why is cellular is not competitive here?

- Federal regulatory policies have helped incumbents
  - Telephone monopolies were granted broad cellular licenses
  - Subsequent cellular/PCS spectrum was fragmented
  - PCS auctions were cost prohibitive for many challengers
  - It is more costly for new players to deploy at PCS frequencies
  - Paired frequency allocations perpetuated the dominance of old mobile standards and large incumbent providers
- Built-in ILEC cellular market advantage
  - Wireline monopoly position helped fund cellular
  - Cellular duopoly saw no formidable competition
  - Controls or controlled by major suppliers
  - Control of cumbersome standards-setting process

Background

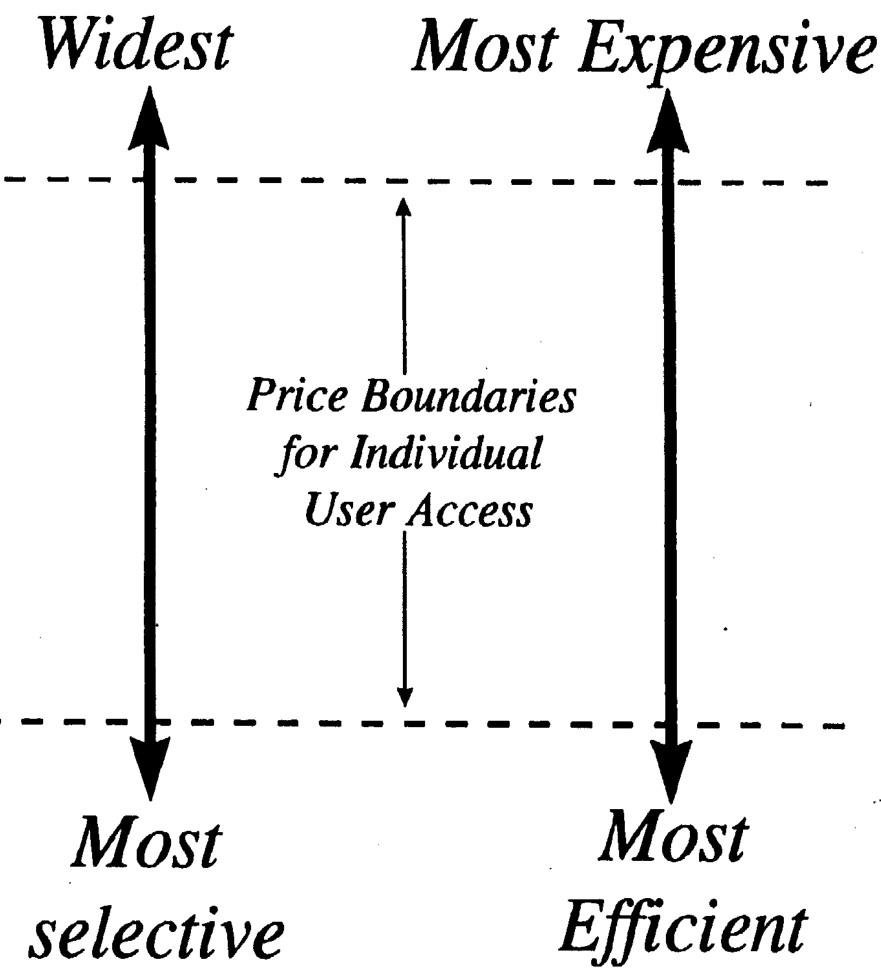
Why hasn't WLL technology taken off yet?

- Technology, marketing and implementation
  - WLL history has been marked by costly and inefficient cellular systems, relabeled as WLL and ushered in by incumbent suppliers
  - Poor early performance resulted in lingering image problems
  - Highly-competitive technologies have entered the market…
  - …but PSTN interconnection (switch interface) barriers have been erected by suppliers of PSTN switching gear
- Populous, developing countries were expected to help drive the economies of scale, but exhibited…
  - Economic turndown has postponed global ramp-up
  - Poor radio regulation and spectrum planning/availability
  - Import tariff barriers/unrealistic local content goals
  - Future economic driver will be Internet access

Wireless Telephony Alternatives

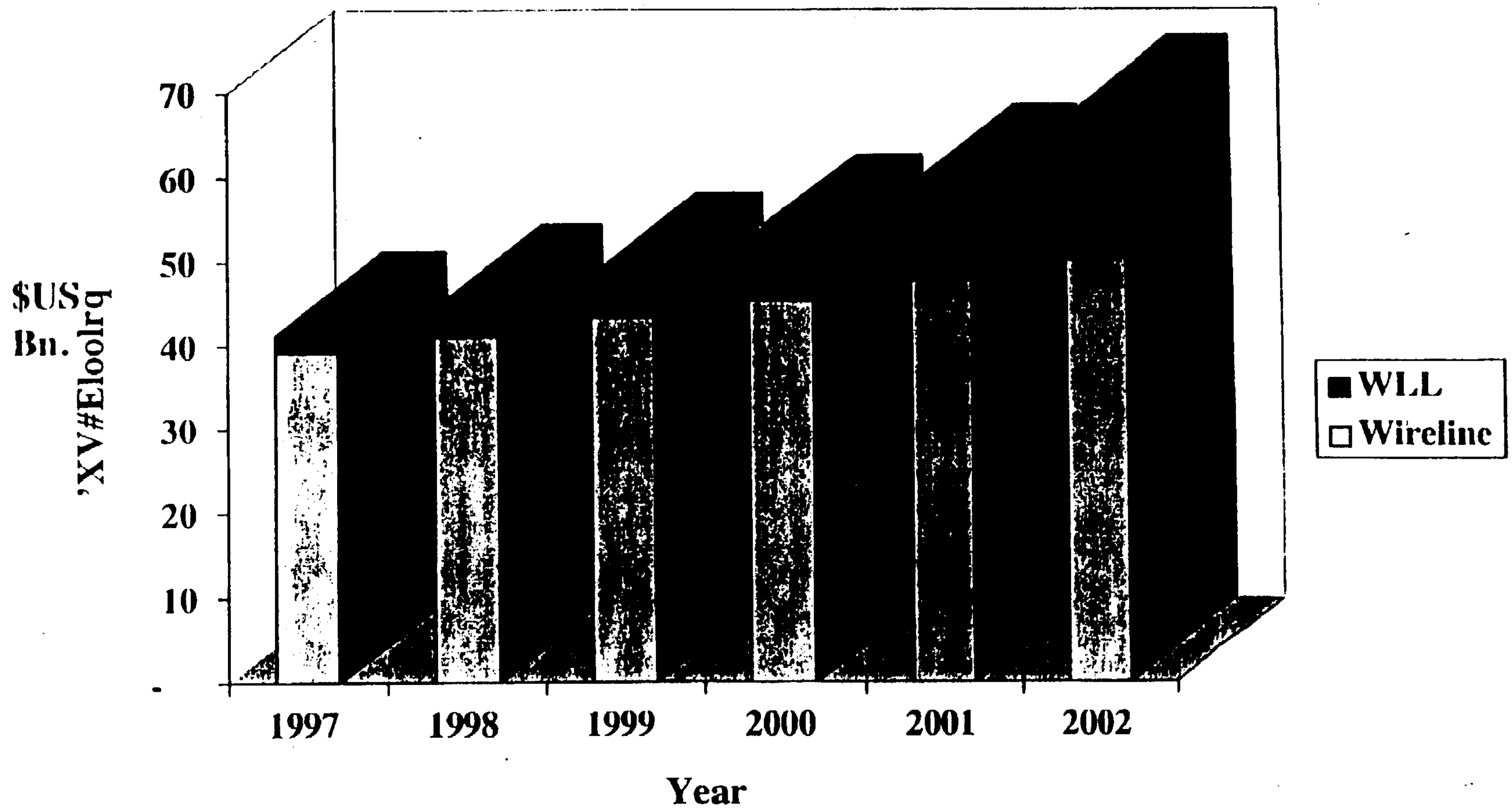
Wireless Coverage Models

- Satellite
- Mobile Cellular/PCS
- Pedestrian Cordless
- Wireless Local Loop
- Microwave



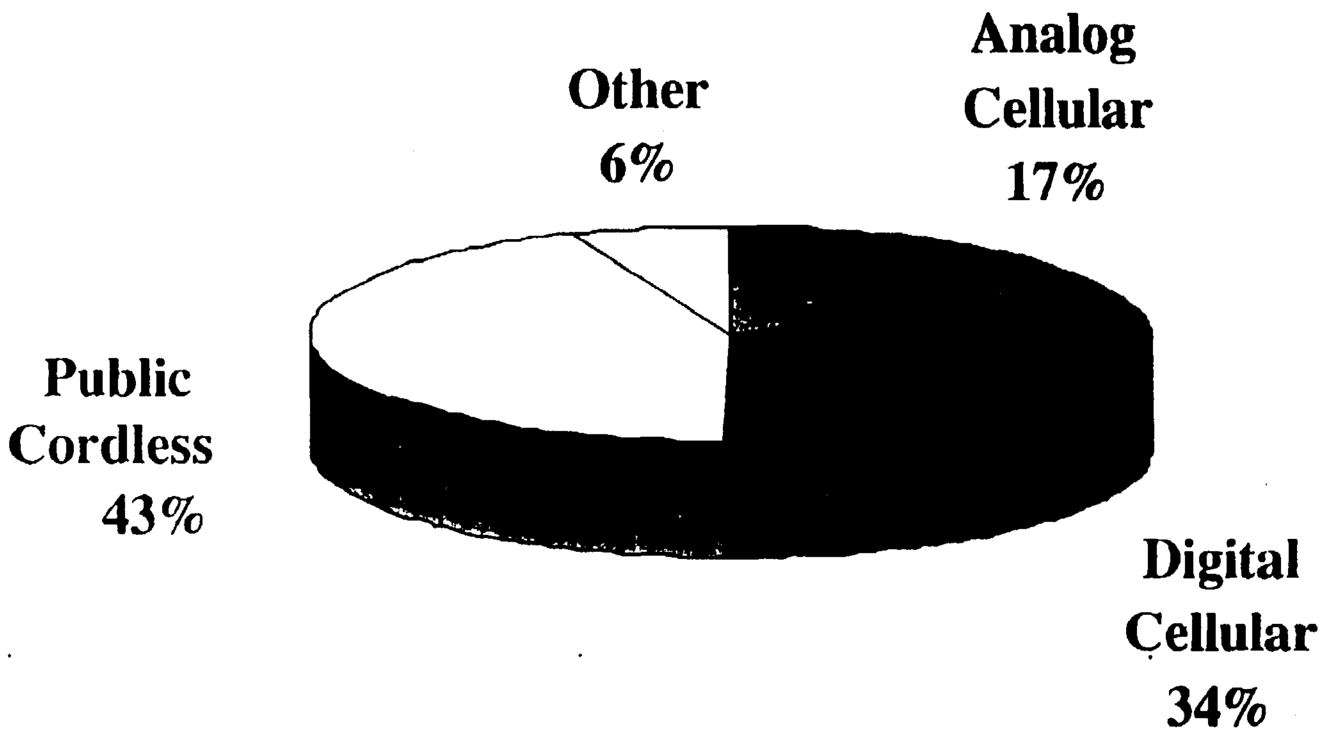
Wireless Telephony Alternatives

Wireless Local Loop Infrastructure Spending Worldwide



Sources: Allied Business Intelligence, OMSYC, ArrayComm
Note: 1997 average project size was < US$5M

Wireless Telephony Alternatives
Wireless Local Loop Market Segmentation*



*Based on an ArrayComm research and analysis of 366 WLL projects worldwide.

Sources: ArrayComm research, Advanced Cordless Communications, Business Wire, CommunicationsNow, FCC, ITC, tele.com, Telecom.Development, Yankee Group

Wireless Telephony Alternatives
Select Fixed Wireless Technologies

- Specialized Solutions
  - Microwave
  - Satellite
  - Terrestrial rural systems
- Mass Market Technologies
  - Fixed Cellular
  - Fixed Cordless
  - True WLL (proprietary systems, enhanced cordless)

Wireless Telephony Alternatives

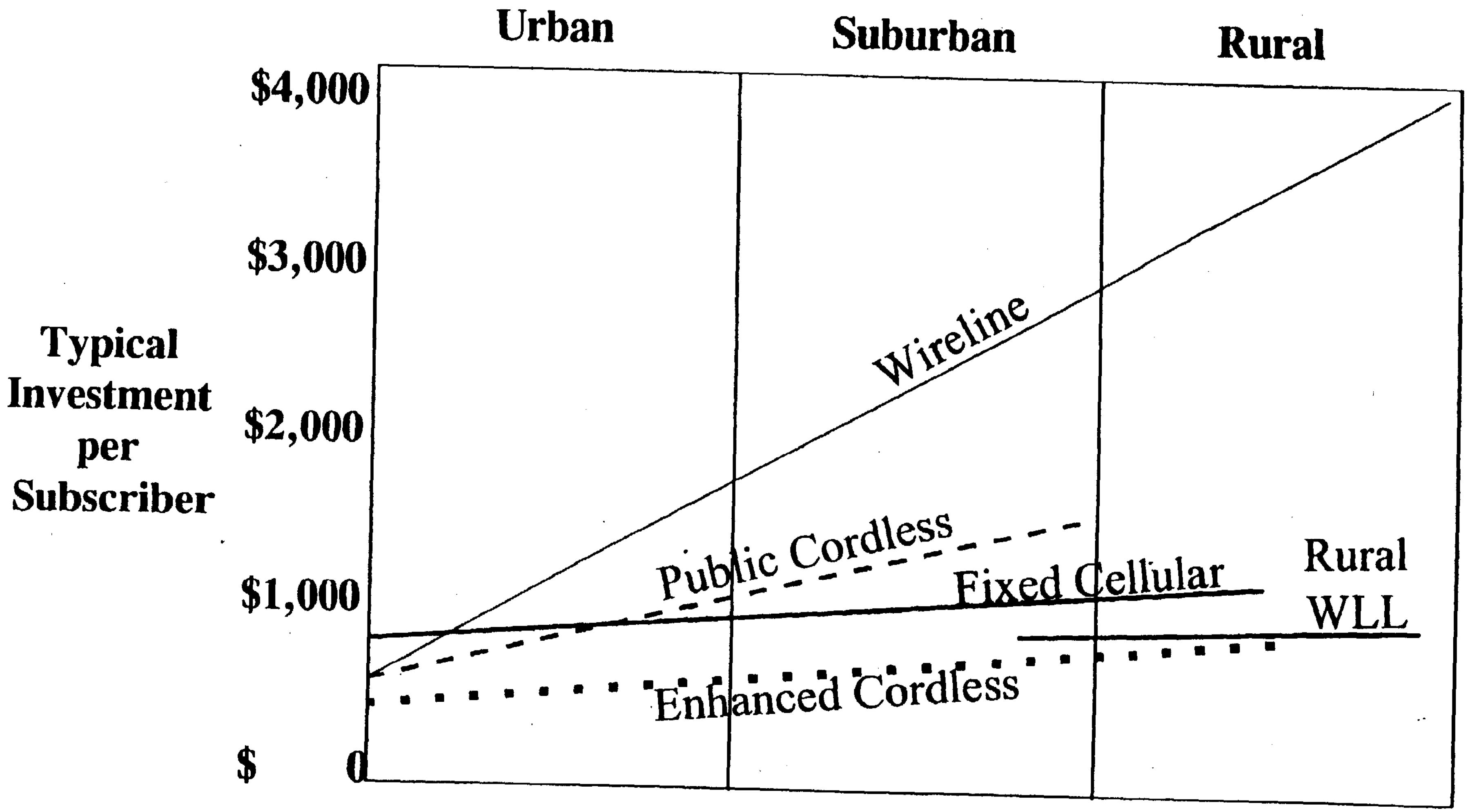
Mass Market Technologies

- Fixed Cellular (i.e., AMPS, TDMA, CDMA)
  - An overlay to the public network
  - Optimized for high-speed mobility
  - Complex planning and implementation
  - Premium cost, quality issues (8-13 kbps voice encoding)
  - Dominated by a few large suppliers
- Fixed Cordless (i.e., DECT, PHS, PACS)
  - An extension to PSTN
  - No radio planning (self-organizing)
  - Low power, coverage limitations
  - Low cost, high quality (32 or 64 kbps voice encoding)

Wireless Telephony Alternatives
True WLL Solutions

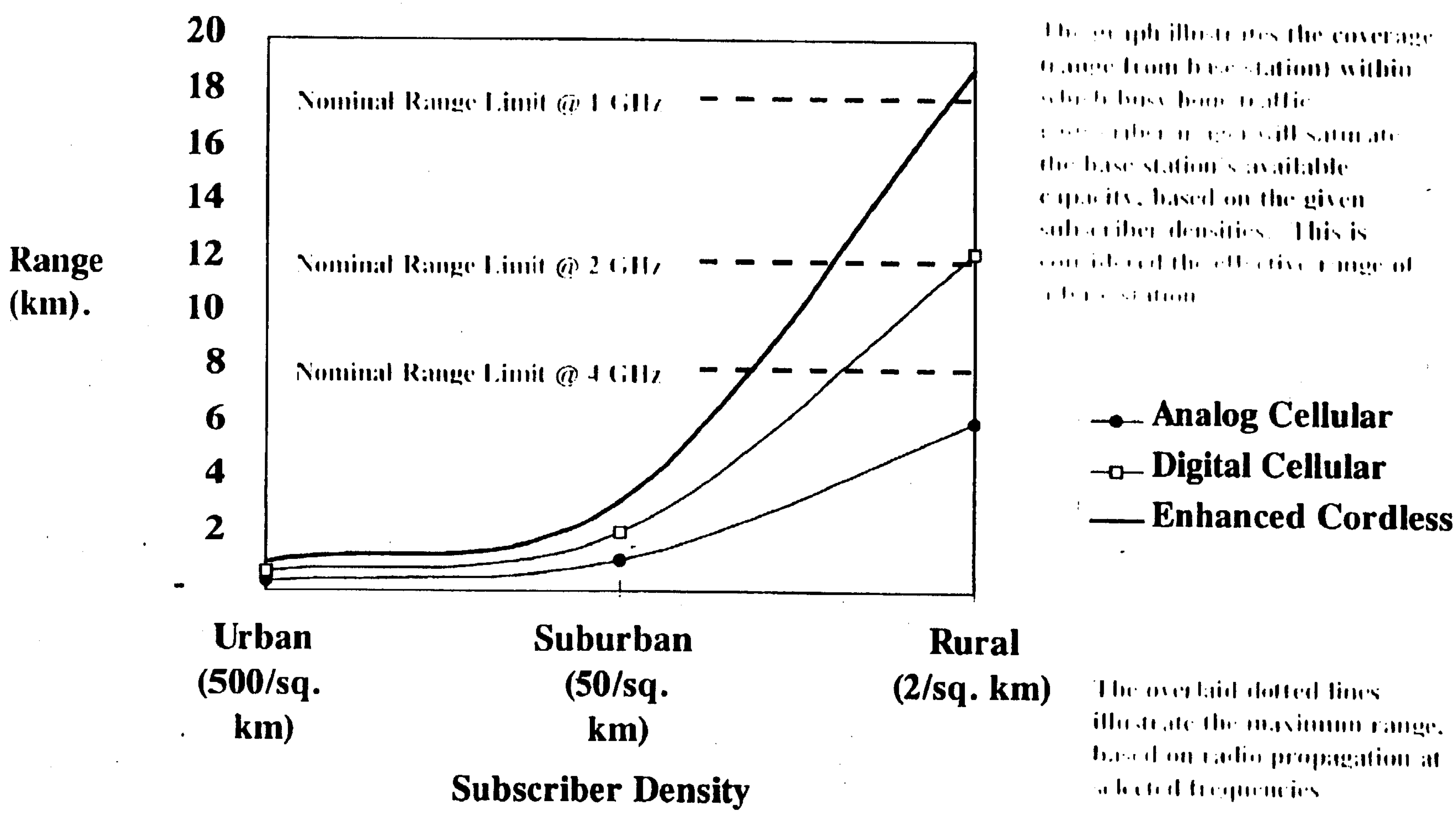
- Proprietary Systems (i.e., B-CDMA)
  - Wide array of technologies, fragmented market and spectrum allocations
  - Generally aimed at high-end of the market, incorporating 32-64 kbps voice and high-speed Internet
- Enhanced Cordless (i.e., long-range/hi-cap PHS)
  - Retains the cost and quality advantages of cordless, but with greater coverage (more suitable for rural areas)
  - Incorporates newer, more efficient technologies, i.e., smart antennas, IP protocol, etc.
  - Protocol modifications allow better transparency to central office- and Internet-based services

Wireless Telephony Alternatives
Price Effectiveness



Wireless Telephony Alternatives

Coverage - Nominal vs. Busy Hour



Technological Developments

Key Wireless Telephony Enablers

- Public Cordless (time division duplex-based)
  - Wireless 32 kbps (ADPCM) encoding (high quality voice)
  - Dynamic channel allocation (no frequency planning)
  - High-speed packet protocol for Internet access
- Network Interfaces (direct PSTN interconnection)
  - Digital interfaces (TR303/V5.2) reduce costs
  - Class 5 service transparency
- Spectrum Enhancements (increased coverage, capacity and reliability)
  - Smart antennas
  - Superconducting filters

Technological Developments

The Spectral Efficiency Bottleneck

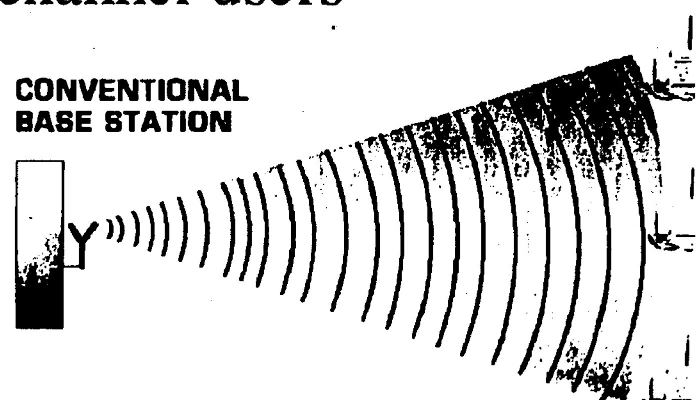
Today's Principal Spectral Inefficiency

omnidirectional/sectorized radiation and reception

Why?

only a tiny fraction of radiated power on uplink or downlink is available to the receiver

the rest - the vast majority - becomes interference for other co-channel users



Technological Developments
The Spectral Efficiency Bottleneck

- Quest For Spectral Efficiency Has Focused on Time/Frequency Processing
  - modulation formats
  - channel and source coding
  - access methods
- (Good) Current Practice Is Near Theoretical Limits
  - all significant capacity gains from these areas have been realized already

Technological Developments

Smart Antennas

- Basic Idea
  - combine multiple antennas and modern signal processing techniques to instantaneously adapt the transmission and reception patterns of the base station to the radio environment, users and interferers
- Smart Antennas Are Spatial Processing Systems
  - can be applied to any air interface
  - significantly increase capacity and spectral efficiency
  - implementations in use worldwide today

Technological Developments
Smart Antennas

} Determinants of Performance

- } environmental complexity: rural is friendliest
- } degree of mobility: fixed is ideal
- } duplexing method: frequency division (FDD) vs. time division duplexing (TDD): TDD gains are higher

Application	Capacity Increase	Deployments
Enhanced Cordless WLL (TDD)	20 x	1996-present
Pedestrian Cordless PHS (TDD)	5 x	1996-present
Mobile Cellular AMPS, GSM (FDD)	>2 x	1993-present

Technological Developments
Smart Antenna Attributes

- Enhanced service quality and reliability
- Expanded coverage
- Greater capacity and higher data throughput
- Transparent to all wireless standards
- Low cost per subscriber
  - less radio spectrum required
  - fewer base stations
  - enables low-power, lower-cost subscriber equipment

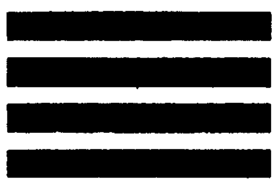
Technological Developments
Conventional Wireless Divides Spectrum

Freq-
uency **Radio Spectrum**

Time

FDMA

Freq-
uency



Time

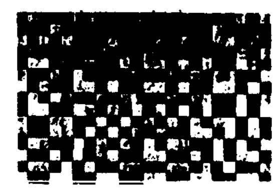
TDMA

Freq-
uency

Time

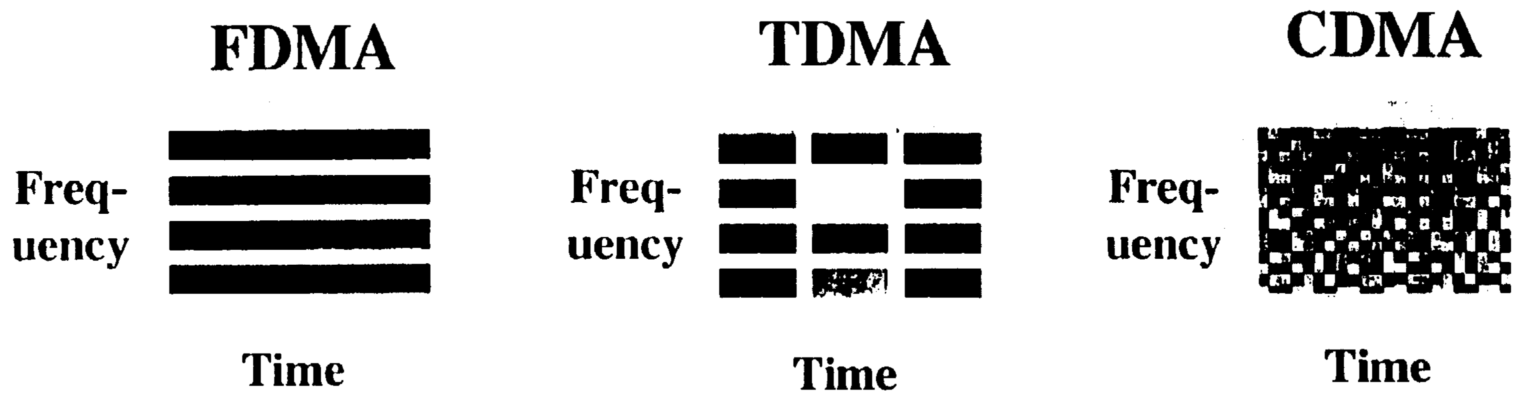
CDMA

Freq-
uency

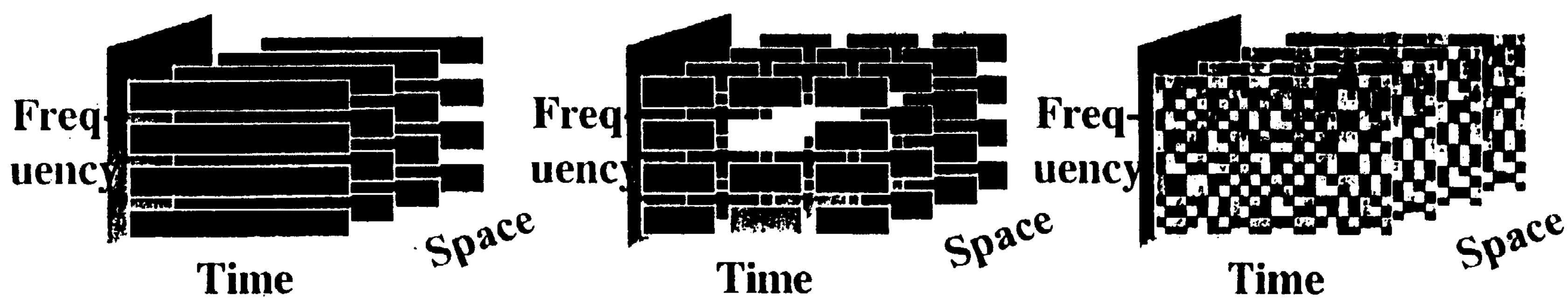


Time

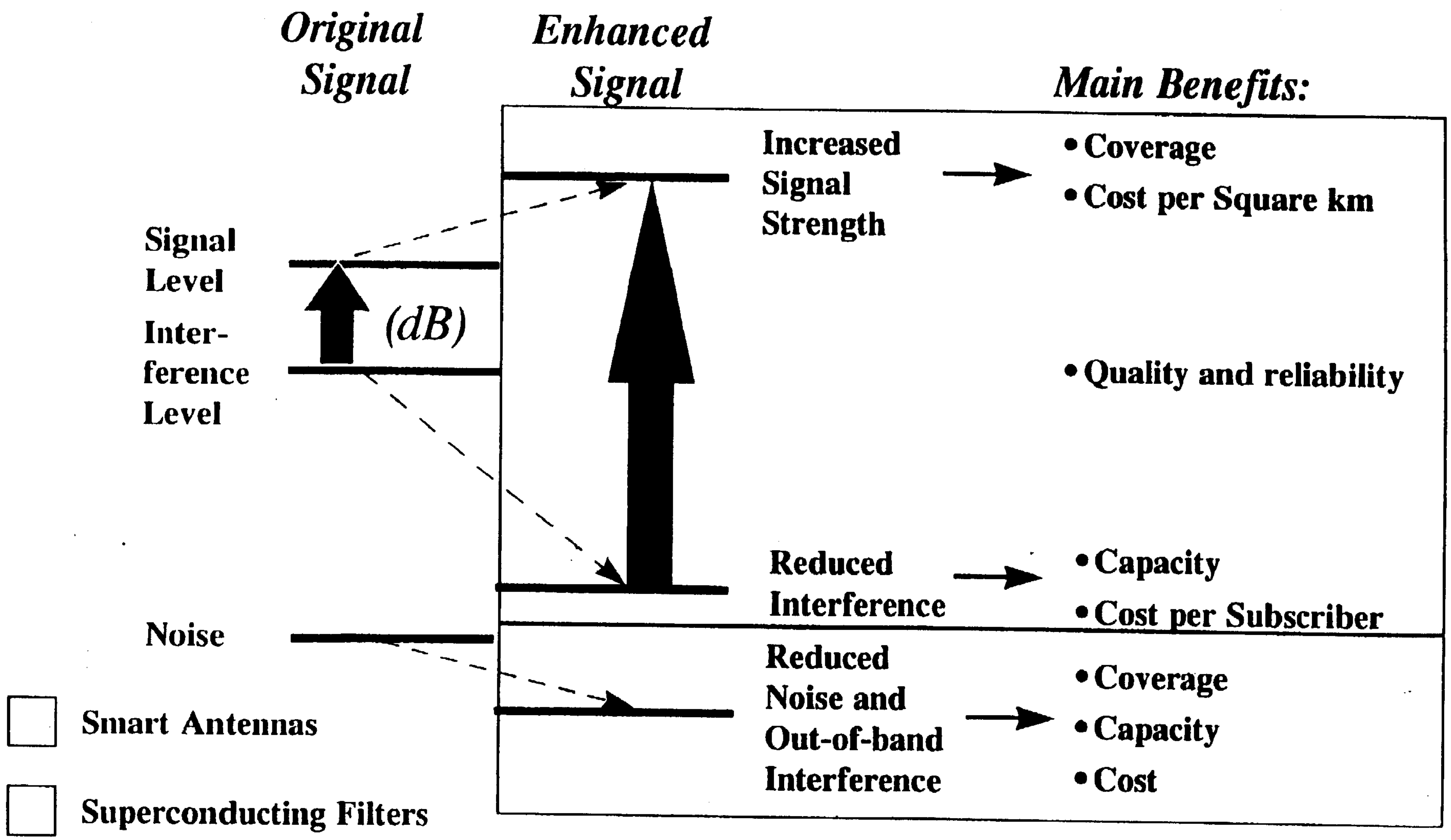
Technological Developments
Smart Antennas Multiply Spectrum



Spatial Channels



Enhanced Signal Quality



Technological Developments
FDD (i.e., cellular) vs. TDD (i.e., cordless)

	Advantages	Disadvantages
FDD	No need for synchronized network Suited to high-power applications Suited to extended range at < 1 GHz	Requires fragmented allocations More challenging for Smart Antennas Relatively hard to support asymmetry Expensive for small duplex distances
TDD	Operates in isolated allocations Well suited for Smart Antennas Cost-reduced user terminals Simple to support asymmetry	Requires synchronized network 50% duty cycle for radio electronics

- Neither is fundamentally more efficient
- TDD is better suited for
  - smart antennas
  - asymmetric data services (Internet)